

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT LEAKING UNDERGROUND STORAGE TANK SECTION

Enclosed are various documents pertaining to IDEM's Leaking Underground Storage Tank Section. This information packet will aid owners/operators in assessing and remediating contaminated sites. The packet follows the outline below. Direct all questions, as to its contents, to the LUST Section of the UST Branch of IDEM at (317) 233-6418.

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Incident Reporting Flowchart (to be inserted here)

I. GENERAL INFORMATION

A. INITIAL INCIDENT REPORTING

Incident reporting to IDEM is required for all sites where contamination is present. In addition to the above information, several other facts must be included when reporting to IDEM. IDEM recognizes two types of release reports: suspected and confirmed.

Suspected releases are recognized as the following:

- * Erratic behavior of product dispensing equipment;
- * Sudden loss of product through inventory control checks;
- * Tank tightness test failure;
- * Water present in UST;
- * Free product present; and
- * Vapors in basements and/or nearby utility lines.

Note: Two failed tank tightness tests is considered a confirmed release.

Owners and operators of the UST system in question, must report to IDEM the suspected release by either telephone (317) 233-6418 or by facsimile (317) 233-6358. The basic information required for reporting suspected releases includes:

1. Facility name, facility address, site contact person w/ phone number & state registration I.D. number;
2. UST system in question - size & product contained;
3. Owner/operator name, address and phone number;
4. Reasons for suspecting a release; and
5. Future investigative steps

Note: Owners and operators have **7 days** to either negate or confirm a suspected release report. If negating a suspected release report, then follow up written documentation must be submitted to IDEM to update the facility file.

When reporting a confirmed release, the following information is required in addition to the information listed above.

6. Location of release (piping lines, dispensing island, UST, joint connections, etc.);
7. Knowledge of release (failed tank tightness test, long-term, analytical results, catastrophic spill, etc.);
8. Affected area(s) (backfill, natural soil, groundwater, utility lines, basements, etc.); and
9. Site specific information (affected utility lines, drinking water intakes, or the detection of free product).

If emergency conditions exist (inhabitable building affected, drinking water affected, utility conduits affected or free product present), then initial reporting must be made **immediately** to (317) 233-7745 (24 hour emergency response phone number). Initial notification to IDEM at (317) 233-6418 (within **24 hours** of knowledge of a release) must include the above information in order to properly evaluate site conditions. Upon completion of initial notification, IDEM will assign an incident number. Please reference this number on all future correspondence to IDEM. Failure to include this number will delay review of documents.

B. SITE PRIORITIZATION

Site prioritization is designed to utilize the most appropriate site characteristics typically available during initial LUST reporting. UST Branch staff involvement is proportioned among the prioritized sites so as to provide the most effective protection of human health and the environment. However, if site conditions change, then the site priority may also change. The following ranking system distinguishes five (5) categories listed in the order from HIGHEST priority to LOWEST priority:

1. Inhabitable building and/or drinking water affected.
2. Groundwater impacted and free product detected.
3. Utility conduit(s) affected.
4. Groundwater impacted without free product detection.
5. Soils only impacted.

Qualifying factors are used to rank sites within each category. A higher factor score is given to those sites that present a greater risk. These factors include:

- a. the proximity of the LUST site to a drinking water intake;
- b. the type of petroleum product released;
- c. the population size affected or at risk, and
- d. the predominant soil type in the area.

Other qualifying factors may include:

- i. amount of product released,
- ii. release duration,
- iii. lateral and vertical extent of groundwater plume,
- iv. groundwater contamination concentration,
- v. groundwater flow direction and velocity.

II. LUST SITE INVESTIGATION REPORT GUIDELINES

A site investigation must be conducted on all sites where the presence of soil or groundwater contamination is suspected. All information requested must be submitted within a **maximum of forty-five (45) days from initial notification**. All objectives of the Indiana Administrative Code Title 329, Article 9, Rule 5, Section 4 (329 IAC 9-5-4) along with federal rules 40 CFR Part 280.62 through 40 CFR Part 280.65 must be achieved in addition to these guidelines. The site investigation report must be submitted in the format presented in these guidelines.

Note: If emergency conditions exist at the time of initial incident reporting or if at any time site conditions dictate the recovery of free product, then all items listed in Parts A, B and C (Background, Incident Description and Initial Response/Abatement and Free Product Removal) must be reported to IDEM within twenty (20) days from incident knowledge (Free product removal must be maintained and reflected on the Corrective Action Progress Report Form for L.U.S.T. Site, submitted at least quarterly, located at the back of the Corrective Action Plan Guidelines). The remaining items listed in Parts D, E, F and G must be submitted within 45 days.

Note: *All site assessments that reveal contamination must be reported to IDEM at (317) 233-6418.*

The goal of a site investigation is to define the extent of contamination. The investigation is conducted to gain an understanding of site conditions in order to select a remediation technology.

A. BACKGROUND

1. Responsible party information must include:
 - a. the owner/operator name and address; and
 - b. past owner/operators.
2. Site specific information must include:
 - a. the facility name, address, phone number;
 - b. type of facility, past and current operations;
 - c. past construction activities;
 - d. spill history;
 - e. site proximity to sensitive areas (schools, municipal well fields, etc.);
 - f. subsurface soil descriptions;
 - g. location of all groundwater wells within 1 mile radius; and
 - h. description of all site work complete to date.
3. Underground storage tank(s) information must include:
 - a. number and volume of tank(s);
 - b. tank(s) construction material and type of leak detection;
 - c. tank(s) past and present contents;

- d. records of most recent tightness test results, inventory records and/or tank gaging records for the past calendar year;
- e. tank(s) age and installation dates; and
- f. UST System Closure report submittal date if applicable.

B. INCIDENT DESCRIPTION

- 1. Incident information must include the following:
 - a. date reported to Indiana Department of Environmental Management at 317/233-6418 or 317/233-7745(SPIL);
 - b. release incident number given by IDEM at time of initial report;
 - c. assigned IDEM site priority ranking obtained at time of initial report;
 - d. material(s) released;
 - e. volume lost;
 - f. area(s) affected (soil, groundwater, sewers, etc.); and
 - g. health and environmental risk(s) associated with the spill incident.

C. INITIAL RESPONSE/ABATEMENT AND FREE PRODUCT REMOVAL

- 1. Initial response and abatement information must include the following:
 - a. detailed descriptions of immediate actions to prevent any further release;
 - b. measures taken to prevent further migration;
 - c. actions taken to identify and mitigate fire and explosion hazards posed by vapors or free product; and
 - d. actions to investigate free product release.
- 2. Free product recovery information must include the following:
 - a. name of person(s) responsible for product removal;
 - b. estimated quantity, type, and thickness of product observed or discovered;
 - c. a description of the recovery system;
 - d. copies of all permits from local, state and federal agencies for handling, treating, discharging and disposing of the contaminants; and
 - e. final disposition of the recovered free product.

D. INVESTIGATIONS

The regional geologic/hydrogeologic setting must be investigated along with site specific conditions. Appropriate site exploration methods include soil borings, monitoring wells, rock

cores, soil gas surveys and other geophysical methods.

1. Regional

a. geologic information:

- (1) types of bedrock;
- (2) soil series description (USDA, Soil Conservation Service);
- (3) list of soil and geologic references used; and
- (4) other information, as necessary.

b. hydrogeologic information:

- (1) depth to groundwater and seasonal fluctuations;
- (2) flow direction(s) and gradients;
- (3) regional hydrogeological references used; and
- (4) other information, as necessary.

c. maps:

- (1) illustrated legends and compass directions and at an appropriate scale (Note: Drawing Not To Scale is inadequate);
- (2) topographic base with ten foot contour intervals;
- (3) location, depth and corresponding IDNR - DOW (Indiana Department of Natural Resources - Division Of Water) well records of high capacity wells (greater than seventy gallons/minute) **and** municipal water supply wells within two mile radius (IDNR - DOW);
- (4) location, depth and corresponding IDNR-DOW well records of smaller wells within a one mile radius;
- (5) site location, other facilities and land use within one mile radius (agricultural, industrial, commercial, etc.); and
- (6) surface water bodies within one mile radius.

2. Site specific

a. geologic information:

A reference for detailed soil description: Description and Sampling of Contaminated Soils, A Field Pocket Guide, U.S. EPA November, 1991.

- (1) a minimum of three (3) on-site, **continuously** sampled soil borings to determine subsurface geology;

- (2) soil borings (accurately field surveyed with a horizontal closure of less than one foot error) placed as needed to confirm extent of soil contamination;
- (3) site soil stratigraphy identification, including cross-sections;
- (4) boring logs that give lithologic descriptions or USDA soil textures, degree of sorting, Munsell Soil colors, sedimentary contacts, gas/vapor readings, etc.;
- (5) boring logs all using the same vertical scale and including surface elevations; and
- (6) other information, as necessary, to describe site conditions.

b. hydrogeologic information:

- (1) depth to groundwater along with seasonal fluctuations (at a minimum, quarterly monitoring events will be required to define seasonal fluctuations);
- (2) flow direction(s) and gradients;
- (3) hydraulic characteristics (hydraulic conductivity, transmissivity, storativity, confined or unconfined conditions, porosity, average linear velocity, etc.) of the aquifer(s) involved. **Note:** if not determined for the specific site, proper source references for estimates must be provided) ;
- (4) a minimum of three (3) monitoring wells screened across water table fluctuation and not placed in a straight line;
- (5) monitoring wells placed as needed to confirm extent of groundwater contamination;
- (6) monitoring well locations surveyed to a temporary bench mark with a vertical accuracy of .01 foot and with a horizontal closure of less than one foot;
- (7) well construction records submitted using the same scale that includes surface and top-of-casing elevations; and
- (8) other information, as necessary.

c. maps & contamination plume identification

Both the horizontal and vertical extent of contamination must be completely defined. Maps must include the following:

- (1) illustrated legends and compass directions and at an appropriate scale;
- (2) topographic base with appropriate contour intervals to accurately describe the site;
- (3) identified above ground features (buildings, roadways, manways, pump islands, property lines, etc.),
- (4) identified subsurface features (tanks, piping, utility conduits, etc.);

- (5) soil boring and monitoring well locations surveyed to a temporary bench mark (accuracy of .01 foot);
- (6) sampling locations (field and laboratory) along with depth and contaminant concentrations;
- (7) horizontal and vertical contaminant plume identification;
- (8) geologic cross sections showing the watertable and illustrating vertical contaminant plume identification; and
- (9) groundwater flow direction(s) **Note:** if free product is present on-site, then maps and flow direction must be corrected accordingly to determine true groundwater depth and flow direction.

E. SAMPLING

1. Field Investigation Techniques

IDEM recognizes the benefit of field investigation techniques to screen and monitor LUST site contamination. These preliminary field investigations can be used to augment the installation of soil borings and groundwater monitoring well locations. However, a sufficient number of soil and groundwater samples must be laboratory analyses to determine the full extent and degree of contamination. IDEM does not recognize field investigation techniques as final site confirmation. Commonly used field investigation procedures include but are not limited to the following:

- (1) "Blind" drilling;
- (2) Geoprobe;
- (3) Test pits/trenches;
- (4) Hydropunch;
- (5) Electronic Cone Penetrating Tests; and
- (6) Other current industry approved methods.

2. Field Screen Samples

IDEM recognizes the benefit of field screening samples to investigate and monitor site contamination remediation. Field screening sample methods are acceptable to investigate contaminated LUST sites. IDEM does not recognize field screening activities as final site confirmation. The use of field GC/MS equipment will be reviewed on a site-by-site basis. Environmental samples obtained from the various field techniques are considered field screen samples not confirmatory samples. Commonly used field screening sample procedures include, but are not limited to, the following:

- (1) Immunoassay;
- (2) H/Nu;
- (3) OVA;

- (4) Gastech; and
- (5) Other current industry approved methods.

3. Laboratory

If persons other than environmental contractors/consultants will be gathering environmental samples, then follow specific requirements the laboratory may have to insure sample validity. These should include sample acquisition, containers, preservation, shipping requirements and time, storage, chain of custody and decontamination of equipment between samples.

Note: Do not send QA/QC information with your submission. Make sure that the laboratory keeps this information to be produced, if requested by IDEM. Do not send samples used for field screening to the lab for analysis. Take two samples (duplicates), use one for field analysis and send the other to the laboratory for analysis.

Proper laboratory samples are required to verify site conditions. Laboratory sampling and analysis methods must be consistent with U.S. EPA publication SW-846 entitled "Test Methods for Evaluating Solid Wastes, Physical and Chemical Methods", 3rd. Edition. The laboratory must be capable of performing the analysis by the appropriate SW-846 method. QA/QC procedures outlined in the methods must be followed with the documentation available if requested.

Sample information that must be included in this report is as follows:

- ! A signed Laboratory Certificate of Analysis listing analysis method, preparation method, date of sample receipt, date of analysis. A statement that the method QA/QC procedures were followed. This QA/QC package must be available if requested by IDEM;
- ! Chain of custody documentation including laboratory receipts;
- ! Decontamination procedures; and
- ! Sampling procedures and techniques.

The following analytical methods and corresponding detection limits are to be used for soil and groundwater sampling of petroleum products. For analysis requirements of other substances please call IDEM's Chemistry Support Section at (317) 233-6465.

a). Soils analysis

FIGURE I: TIER I SOIL ANALYSIS

Possible Contaminant	Parameters to be Analyzed	Acceptable Methods	Detection Limits
Kerosene, Gasoline	Total Petroleum Hydrocarbons (TPH)	GC/FID 8015 - Modified (Calif.) or GC/MS 8240/60	20 ppm (mg/kg)
Naphtha, Diesel	TPH	GC/FID 8015 - Modified (Calif.) or GC/MS 8270	20 ppm (mg/kg)
Waste Oil!	TPH	418.1 IR	20 ppm (mg/kg)

Note: ! Soils contaminated from waste oil must be segregated from other contaminated soils excavated on-site. Waste oil contaminated soils must be characterized and disposed of properly. It is recommended to obtain two sets of confirmatory soil samples. In the event that the confirmatory sample located in close proximity of a known waste oil contamination source (i.e. UST location) is **>100ppm TPH** (418.1 IR), then the laboratory should run the second set for VOC's, Total SVOC's, Metals and PCB's.

If initial waste oil soil sampling for TPH (418.1 IR) is **greater than 100 ppm** with the laboratory detection limit of 20 ppm, then analyze soil samples located in close proximity to the waste oil source for the following parameters:

FIGURE II: TIER II SOIL ANALYSIS FOR WASTE OIL

Possible Contaminant	Parameters to be Analyzed	Acceptable Methods	Detection Limits
Waste Oil	VOC! and	GC/PID 8020 or GC/MS 8240/60	20 ppm (mg/kg)
	Total SVOC and	GC/MS 8270	20 ppm (mg/kg)
	PCB and	GC/ECD 8080/8081	1 ppm (mg/kg)
	Metals! !	use the appropriate SW-846 Method	set by the appropriate method

Note: ! This analysis should include Methyl-tertiary-butyl-ether (MTBE)

! ! Metal scans must include: Barium, Cadmium, Chromium (total), Lead, Mercury, Nickel, and Zinc.

b). Groundwater analysis

FIGURE III: TIER I GROUNDWATER ANALYSIS

Possible Contaminant	Parameters to be Analyzed	Acceptable Methods	Detection Limits
Kerosene, Gasoline	Benzene, Toluene, Ethylbenzene, Xylene (BTEX)! ,	GC/PID 8020 or GC/MS 8240/60 or GC/MS 524.2	5 ppb (ug/L)
Naphtha, Diesel	BTEX!	GC/PID 8020 or GC/MS 8240/60 or GC/MS 524.2	5 ppb (ug/L)
	Total Semi-Volatile Organics (SVOC),	GC/MS 8270 or GC/MS 525	10 ppb (ug/L)
Waste Oil	TPH (Total Petroleum Hydrocarbons)	418.1IR (or current version)	1000 ppb (ug/L)

Note: ! This analysis should include Methyl-tertiary-butyl-ether (MTBE).

If initial sampling indicates groundwater TPH levels of **greater than 1,000 ppb** (parts per billion) *in close proximity to a potential waste oil source*, then analyze those groundwater wells that are found in close proximity and downgradient for the following additional parameters:

FIGURE IV: TIER II GROUNDWATER ANALYSIS FOR WASTE OIL

Possible Contaminant	Parameters to be Analyzed	Acceptable Methods	Detection Limits
Waste Oil	VOC! and	GC/PID 8020 or GC/MS 8240/60	5 ppb (ug/L)
	Total SVOC and	GC/MS 8270	10 ppb (ug/L)
	PCB and	GC/ECD 8080/8081	0.5 ppb (ug/L)! !
	Metals! ! !	use the appropriate SW-846 Method	set by the appropriate method

Note: ! This analysis should include Methyl-tertiary-butyl-ether (MTBE)

!! PCB Aroclor 1254 and 1260 detection limit must be 1.0 ppb.

!!! Metal scans must include: Barium, Cadmium, Chromium (total), Lead, Mercury, Nickel, and Zinc.

IDEM recognizes that several analytical methods exist to test for hydrocarbon constituents. The methods listed are recommended because they are widely known techniques often used in analytical laboratories and by regulatory agencies. The use of an alternative test method that will properly characterize the presence of contaminants at detection levels equal to or less than the methods listed may be requested of IDEM per the following procedures.

The procedure for requesting an alternative analytical testing method for hydrocarbon constituents is as follows. A copy of this request must be sent to the LUST program.

- a. all applicants must send a written request for acknowledgement of the alternative method to :

**IDEM/Office of Environmental Response
Chemistry Section, P.O. Box 7015
N-1255, 100 N. Senate Ave.
Indianapolis, IN 46206-6015**

- b. the letter must contain the following:
 - (1) site name and address,
 - (2) IDEM assigned incident number and facility identification number,
 - (3) type of contaminant,
 - (4) test method substitution, and
 - (5) reason(s) for substitution.
- c. the Technical Support Branch, Chemistry Section will send a letter of acceptance or denial for the test method substitution to the applicant.

F. RESULTS/CONCLUSIONS

Discuss the results of the site investigation. Include all field and laboratory sample results in a tabular format.

G. RECOMMENDATIONS

Feasibility studies must be taken into account when recommending remediation alternatives. These studies must also be site specific and included in this section. Discuss effective remediation alternatives and for each alternative address the following:

1. Overall effectiveness of technology;
2. Ability to achieve clean up criteria;

3. Expected treatment duration;
4. Treatment reliability; and
5. Anticipated permits required.

THIS REPORT MUST BE SIGNED BY AN EXPERIENCED ENVIRONMENTAL PROFESSIONAL (ENGINEER, GEOLOGIST, HYDROGEOLOGIST, C.H.M.M., etc.)

LUST SITE INVESTIGATION REPORT GUIDELINES

ADDENDUM ONE: IDEM RECOMMENDATIONS

These recommendations are meant to serve as helpful aids during proper site investigations and must not be considered as required by the IDEM LUST Program.

Soil Excavation at UST Closure/LUST Sites

Overexcavation activities are a common remedial plan for low priority sites. However, overexcavation may not be appropriate in the following circumstances:

- ! Where contaminated soil is overlain by a considerable thickness of clean soil, and/or
- ! Where more soil is contaminated than is economically practical to treat on-site/off-site or to dispose.

The decision to overexcavate must be based on knowledge of contaminated soil volume. It is recommended that in situations where contamination extends more than **15 feet** from the tank pit, contractor/consultants should consider common field investigative techniques such as: blind drilling, test pits, trenches, soil gas surveys or other methods to determine the extent of contamination before proceeding with additional excavation.

All soils from borings or excavated from test pits or trenches must be placed on plastic, bermed and covered with plastic. Contaminated soils **can** be returned to the excavation, test pits and trenches **only** if they will be remediated in the future.

Based on a knowledge of the maximum extent of contamination, and before further over-excavation, the owner/operator and consultant should decide together whether alternatives other than excavation would be more cost effective.

Soil Sampling at UST Closure/LUST Sites

IDEM recommends that after the initial zone of known contamination is located (UST pit), field investigations can proceed radially outward until the full extent is defined both horizontally and vertically. Obtain field soil samples; 1) at every change in soil type; 2) directly above the water table; and 3) at obvious signs of soil contamination. When obtaining soil samples from soil borings always grab samples from the highest screened interval and at the bottom of the boring or at the water table.

Do Not send field screen samples to a laboratory. Duplicate samples are required for final laboratory confirmation. Field GC/MS samples may be acceptable as final confirmation. However, this must be reviewed by IDEM staff and will be handled on a site-by-site basis. Standard operating procedures, operator training, experience and the use of a standard calibration gas all will be reviewed and approved prior to the acceptance of field GC/MS samples.

Regional Hydrogeologic Information

In the anticipation of the development of wellhead protection areas throughout Indiana, the location of a LUST site within a defined wellhead protection area will affect how the site might be prioritized. Information about where the site falls within a wellhead protection zone should be included in the LUST Site Investigation.

This information should include the areal extent of the 1, 5 and 10 year time of travel capture zones for any wellhead protection area in which the site is located (Wellhead protection area information is available from IDEM Office of Water Management, Groundwater Section).

III. LUST SITE CORRECTIVE ACTION PLAN GUIDELINES

Before effective site remediation can occur, an adequate understanding of site conditions must be known. Proper site investigations are outlined in the LUST SITE INVESTIGATION GUIDELINES. The goal of a site investigation is to fully define the extent of contamination. A Corrective Action Plan will not be considered for IDEM review unless a proper site investigation report is submitted. Site remediation plans are based on a variety of site specific conditions. The performance objectives include, but are not limited to, the following:

- ! To reduce contaminant vapors in buildings, or other spaces to below explosive and health threatening levels;
- ! Mitigate further contaminant releases and off-site migration; and
- ! The cleanup of contaminated soil and groundwater.

A Corrective Action Plan **must** be developed for all sites with soil and/or groundwater contamination. All information requested in the Indiana Administrative Code Title 329, Article 9, Rule 5, Section 7 (329 IAC 9-5-7) and 40 CFR 280.66 must be achieved in addition to these guidelines. Submittal will be reviewed together and information can be referenced to previous reports submitted to IDEM. The Corrective Action Plan must follow the format presented in this guidance document.

A. EXECUTIVE SUMMARY

The Executive Summary is a site briefing, in narrative form, highlighting events and other information that led to the development of the Corrective Action Plan.

B. CONTAMINANT and SITE CONDITIONS

To develop a proper Corrective Action Plan, the following contaminant and site conditions must be addressed and submitted in narrative form:

1. Contaminant(s) identification along with chemical and physical properties;
2. Contaminant(s) toxicological data;
3. Potential effects of residual contamination;
4. Site specific soil and hydrogeologic characteristics;
5. Local proximity of surface waters and groundwater along with water quality data;
6. Current and future uses of local water sources;
7. A summary of all site specific water quality data generated during previously completed site investigations; and
8. Other relevant information to describe site conditions.

C. HEALTH AND SAFETY PLAN

To ensure personnel safety during site remediation, a comprehensive Health and Safety Plan must be developed and followed. The plan must include, at a minimum, the following:

1. Known hazards and risk evaluation associated with all site activities;
2. List of personnel along with their alternates and areas of responsibility;
3. Levels of personal protection;
4. Decontamination equipment and procedures;
5. Site access control measures;
6. Site emergency procedures, medical care availability and routes to care facilities;
7. List of emergency phone numbers (fire, police, ambulance and hospital);
8. List of personnel training qualifications and certifications; and
9. A description of how the plan will meet U.S. EPA & OSHA regulations concerning health and safety.

D. MAPS

These maps can be reproduced from previously submitted and approved site investigation reports.

1. Regional map:
 - a. illustrated legends and compass directions and at an appropriate scale;
 - b. a legible topographic base with ten foot contour intervals;
 - c. location and depth of high capacity wells (greater than seventy gallons per minute) within two mile radius (IDNR - Water Division);
 - d. location and depth of smaller wells within one mile radius;
 - e. identified facilities and land use within one mile radius (agricultural, residential, commercial, industrial);
 - f. locations of surface water bodies within one mile radius; and
 - g. site location.
2. Site map:
 - a. illustrated legends and compass directions and at an appropriate scale;
 - b. topographic base with appropriate contour intervals to accurately describe the site;
 - c. identified above ground features (buildings, roadways, manways, pump islands, property lines, etc.);
 - d. identified subsurface features (tanks, piping, utility conduits, etc.);
 - e. soil boring and monitoring well locations surveyed to .01 foot accuracy from an on-site temporary bench mark;
 - f. sampling locations (field and laboratory) along with depth and contaminant

- concentrations;
 - g. contaminant plume delineation; and
 - h. groundwater flow direction(s).
3. Geologic/Hydrogeologic maps:
- Geologic/hydrogeologic illustrations that adequately describe subsurface features and contaminant plume identification:
- a. Cross sections;
 - b. Fence diagrams; and
 - c. Geophysical profiles and/or maps (if performed).

E. SELECTED REMEDIATION TECHNOLOGY

Site conditions and contaminant types will dictate the remediation technology(s) needed to effectively cleanup the site. Prior feasibility studies must show selected remediation technology effectiveness. This section must include:

- 1. Conclusions why the technology(s) selected will be effective based upon physical and chemical characteristics of soil, groundwater and contaminant conditions;
- 2. A detailed description of the selected technology(s), design explanations and illustrations;
- 3. Projected contaminant removal and/or treatment rates;
- 4. Technical specifications of equipment and process; and
- 5. The location of remediation equipment shown, to scale, on a site specific map.

F. SAMPLING PLAN

The performance of the treatment system must be continually monitored to ensure effective remediation. **Quarterly sampling is a minimum requirement.** A sampling and analysis plan must be developed to evaluate the performance of the technology(ies) selected. This plan must include the sampling procedures as outlined in the LUST SITE INVESTIGATION REPORT GUIDELINES (page 3-7).

G. TIME TABLE

A projected work schedule must include the following (this information would best be shown on a Gandt chart):

- 1. Installation and implementation dates;
- 2. Sampling events;
- 3. Progress milestones;
- 4. Completion dates;
- 5. Other relevant information.

H. PROGRESS REPORTING

Upon IDEM corrective action approval and implementation, progress reports must be submitted with at least quarterly sampling results. The results must be reflected on a Corrective Action Progress Report Form for L.U.S.T Sites as found following this page. At the end of the project, a final report must be filed to document that the cleanup goals and objectives have been achieved. These reports must contain:

1. Brief narrative of the remediation process;
2. Data from the performance monitoring plan graphically displayed to show remediation effectiveness; and
3. Other documentation to support the conclusions.

ALL REPORTS MUST BE SIGNED BY AN EXPERIENCED ENVIRONMENTAL PROFESSIONAL (ENGINEER, GEOLOGIST, HYDROLOGIST, C.H.M.M. , etc.)

Additional copies of the progress form are obtainable from IDEM at (317) 233-6418.

IV. LUST SITE CLEANUP OBJECTIVES

In order to determine when a petroleum contaminated site has been successfully remediated, it is first necessary to develop cleanup criteria. Ideally, the goal for conducting cleanups would be the elimination of all contamination. Realizing that this may not be a practicable goal, IDEM has established the following cleanup guidelines for soil and groundwater at LUST contaminated sites. **The following objectives are not to be used as reporting thresholds for releases.**

A. SOIL

IDEM's main concern with contaminated soils remaining on-site is it's potential continuing source of contamination to groundwater. The soil cleanup objectives may not apply when groundwater is encountered during the UST removal or site investigation. If groundwater is already impacted, it is an economic decision to be made by the UST owner/operator and their consultant/contractor to determine how much soil should be removed. This decision involves looking at soil removal costs and long-term groundwater cleanup costs.

On typical UST sites where a combination of contaminant sources exist, the site soil cleanup would be dictated by the most stringent objective.

Soil cleanup objectives for LUST sites are as follows:

- ! Removal of all visible/odorous contaminated soil;
- ! TPH levels of less than 100 ppm for on-site areas; and
- ! TPH levels of Non Detect at 20 ppm for off-site areas.

1. Petroleum products other than Waste Oil

The maximum level of soil contamination that will be allowed to remain on-site after cleanup activities is 100 ppm (parts per million) TPH (Total Petroleum Hydrocarbons). This applies only to sites where the petroleum contamination does not extend off site and where no known groundwater is affected.

- a. on sites where groundwater is affected or potentially affected, the petroleum contaminated soil must achieve cleanup levels low enough to support the U.S. EPA published MCL's (Maximum Contaminant Levels) for groundwater. However, the soil contamination level still cannot exceed the 100 ppm TPH level established above.
- b. where soil contamination extends off-site the cleanup criteria is N.D. (non detect) at 20 ppm (parts per million) TPH (Total Petroleum Hydrocarbons), using the approved testing methods and detection limits.

TPH	100 ppm
(Total Petroleum Hydrocarbons)	(parts per million)

2. Waste Oil

IDEM recognizes a two tier soil sampling strategy when dealing with waste oil contamination. The initial sampling involves sampling within close proximity to the tank for TPH. In the event that the first sample, located in close proximity (UST excavation) of a known waste oil contamination source is > 100 ppm TPH, then further soil sampling must include VOC's, Total SVOC's, Metals and PCB's (Please reference page 3-9 of the LUST SITE INVESTIGATION REPORT GUIDELINES. for acceptable soil waste oil sampling methods and detection limits)

The maximum level of waste oil soil contamination that will be allowed to remain on-site after cleanup activities is 100 ppm (parts per million) TPH (Total Petroleum Hydrocarbons). PCB's and Metals cleanup objectives will be site specific. This applies only to sites where the petroleum contamination does not extend off site and where no known groundwater is affected.

- a. on sites where groundwater is affected or potentially affected, the waste oil contaminated soil must achieve cleanup levels low enough to support the U.S. EPA published MCL's (Maximum Contaminant Levels) for groundwater. However, the soil contamination level still cannot exceed the 100 ppm TPH level established above.
- b. where soil contamination extends off-site the cleanup criteria is N.D. (non detect) at 20 ppm (parts per million) TPH (Total Petroleum Hydrocarbons), using the approved testing methods and detection limits.

TPH (Total Petroleum Hydrocarbons)	100 ppm (parts per million)
-----	-----
VOC	site specific
Total SVOC	site specific
PCB's	site specific
Metals	site specific

3. Hazardous Substances

For LUST sites with hazardous substances, soil cleanup guidelines are site specific and reviewed by IDEM on an individual basis.

B. GROUNDWATER

The expectations are to meet the MCL's (Maximum Contaminant Level) for every known groundwater contaminant constituent. However, IDEM recognizes that site specific conditions may exist that might make groundwater cleanup objectives unattainable. Thus, IDEM will consider alternate cleanup objectives after demonstration of these site specific conditions but only if no human health risk is evident. The following parameters are considered:

On typical UST sites where a combination of these contaminant sources exist, then the site groundwater cleanup would be dictated by the most stringent objective.

Groundwater cleanup objectives for LUST sites are as follows:

- ! Gasoline and Kerosene: B.T.E.X (Benzene, Ethylbenzene, Toluene and Xylene) MCL's;
- ! Naphtha and Diesel: B.T.E.X MCL's, Total SVOC (Semi-Volatile Organic Compounds) and ;
- ! Waste Oil: TPH (if less than 1,000 ppb), Total SVOC and B.T.E.X, PCB and Metals MCL's; and
- ! Hazardous substances: specific to hazardous substance.

1. Gasoline and Kerosene

Cleanup standards for all gasoline contaminants in groundwater must fall below the U.S. EPA published Maximum Contaminant Levels (MCL's). For gasoline contamination, the groundwater must be analyzed for VOC's. MTBE is requested to aid in the evaluation of the full extent of contaminant plume identification but does not currently have a cleanup objective. If no published MCL's exist for the contaminants present, then IDEM will conduct a site specific review to determine appropriate cleanup levels.

MCL's cleanup objectives for gasoline contaminated groundwater are as follows:

Benzene	5 ppb (parts per billion)
Ethylbenzene	700 ppb
Toluene	1,000 ppb
Xylene	10,000 ppb

2. Naphtha and Diesel

For Naphtha and Diesel, the groundwater must be analyzed for: Benzene, Toluene, Ethylbenzene, Xylene (B.T.E.X) and Total Semi-volatile Organics (SVOC). Cleanup objectives for all contaminant constituents in groundwater must fall below the U.S. EPA published Maximum Contaminant Levels (MCL's). If no published MCL's exist for the contaminants present, then IDEM will conduct a site specific review to determine appropriate cleanup levels.

Benzene	5 ppb (parts per billion)
Ethybenzene	700 ppb
Toluene	1,000 ppb
Xylene	10,000 ppb
Total SVOC	100 ppb (parts per billion)

3. Waste Oil

If groundwater is encountered, IDEM recognizes a two tier groundwater sampling strategy when dealing with waste oil contamination. The initial sampling involves sampling within close proximity to the tank for TPH (Total Petroleum Hydrocarbons). In the event that the first groundwater sample located in close proximity (UST excavation or nearest downgradient monitoring well) of a known waste oil contamination source is > 1,000 ppb TPH (418.1 IR), then further groundwater sampling must include VOC's, Total SVOC's, PCB's and Metals. Please reference page 3-10 of the LUST SITE INVESTIGATION REPORT GUIDELINES.

TPH	1,000 ppb (parts per billion)
-----	-----
VOC	MCL's
Total SVOC	MCL's
PCB's	MCL's
Metals	MCL's

4. Hazardous Substance

For hazardous substances, groundwater cleanup objectives will be site specific and contaminant specific. Contact IDEM, Technical Support Program, Chemistry Section for proper test parameters and laboratory detection limits.

Note: IDEM may require different site specific cleanup criteria when site conditions warrant or if new technical information becomes available for the site. The cleanup criteria, as a whole, are subject to change if state and/or federal regulations are adopted which set soil and groundwater cleanup standards.

V. LAND TREATMENT GUIDELINES (petroleum contaminated soils)

Land Treatment, as presented in this document, is an **on-site** remediation process in which contaminated soils are spread on an impermeable barrier to allow the contaminants to volatilize and degrade. It is cost effective and possesses a general pay-off in decreased contaminant levels and treatment time for an increase in management and activities. When remediated soils attain non-detectable levels, responsible parties can eliminate landfill liability and spare precious landfill space.

The first choice in bioremediation tends toward using the indigenous microbial population and stimulating its activity (biostimulation). However, it is possible to add bacteria cultured for the specific contaminant (bioaugmentation). Bioaugmentation can be useful when indigenous bacteria are not available to degrade the organic chemical as when a spill is recent. Bacteria need enough time to mutate, acclimate and increase their population in order to be effective in the degradation process. Enhanced biodegradation is effective in decreasing the remediation time.

The type and level of contamination as well as soil type will determine the length of time required to remediate the soil. Shorter chained hydrocarbons (gasolines) will take less time to degrade than longer chained hydrocarbons (diesel). Clay rich soils will bind up contaminants and require longer remediation time. In order for this remediation technique to be fully beneficial, the treatment cell location must be available long enough to remediate the contaminated soil.

Air emission controls must be registered with the Office of Air Management. Registration is required for facilities that have the potential emissions of greater than twenty-five (25) pounds per hour or fifteen (15) pounds per day of volatile organic compounds. Land Treatment might not be allowed in areas identified as non-attainment zones by the Air Management Section of IDEM. Contact the Office of Air Management (317) 232-5586 for further guidance. Discharges of runoff and treated leachate may require an NPDES permit from the Office of Water Management at (317) 232-8476.

The Land Treatment plan must be submitted to IDEM and follow the format presented in this guidance document.

A. TREATMENT CELL CONSTRUCTION

Proper cell construction is necessary to protect the environment during the remediation process. Plans must be concise, in narrative form and include the following:

1. An amended LUST Site Investigation map showing treatment area;
2. Treatment cell illustrations that include the following:
 - a. construction diagrams with dimensions,
 - b. cross sections with dimensions, and

- c. all measurements and locations of anything concerning the treatment project design (soil depth, buffer zones, water collection, etc.).
3. Description of cell construction;
4. Description of impermeable layer (at least twelve (12) mils thick);
5. Description of berm construction (at least six (6) inches above upper soil layer level);
6. Water run-off and leachate collection system, sampling and disposal procedures;
7. Local land use; and
8. Depth to groundwater and type (perched, seasonal).

The location should be chosen to provide enough space for the soil to be spread no more than eighteen (18) inches thick. It may be acceptable to design the treatment cell to accommodate soils in several layers, however the soils must still be treated and sampled in eighteen (18) inch thick layers.

Room also must be allotted for berms, heavy equipment maneuvering, and contaminated water containment and treatment.

Always determine the seasonal high water table for the treatment location. A site that is dry in summer may pond with water for several months in the spring. The treatment cell must be kept out of drainage ways. Even small drainage ways can channel a large amount of unnecessary water that must be contained and treated.

Adjacent land use must be considered. Site access must be controlled, especially if in a populated area. Refer to the LUST SITE CORRECTIVE ACTION PLAN GUIDELINES (page 3-15) for the requirements of a Health and Safety Plan.

B. TREATMENT INFORMATION AND ACTIVITIES

The following initial information must be included in the work plan:

1. Initial contamination levels (field instruments can be used to determine initial contaminant levels);
2. Soil volume to be treated;
3. Tilling schedule; and
4. When applicable:
 - a. nutrient application rates,
 - b. moisture adjustments,
 - c. pH adjustments,
 - d. bacteria additions (type, application rate, media), and
 - e. pretreatment levels of these factors.

There are many factors that improve the rate of biodegradation. They are briefly discussed below. When known, general ranges for optimum bacteria activity are given. Adjusting

the most limiting factors will increase the rate of biodegradation and shorten the remediation time.

Nutrients: Nutrients can be adjusted to make an ideal environment for the bacteria to degrade the organic contaminants. In order for nutrients to be beneficial, they need to be in a usable form, appropriate concentrations and proper ratios. Commercial fertilizers and farm manures can be used to supply the necessary nutrients. Backfill or natural materials from ten feet below the soil surface have little, if any, organic matter to supply bacteria with needed nutrients.

Macronutrients include: Nitrogen, Phosphorus, Potassium, Calcium, Magnesium and Sulfur. Of the six macronutrients, Nitrogen and Phosphorus have received the most research attention. Nitrogen and Phosphorus are readily available, inexpensive and easy to apply. Application rates and the optimum range will depend on the site. Nitrogen and Phosphorus are usually limiting factors and their addition should enhance bioactivity. Typical C:N:P ratios for optimal nutrient addition are 100:10:1 respectfully.

Moisture: Microorganisms will go dormant at moisture extremes but will become active when favorable conditions return. Moisture control is simple: provide drainage within the treatment cell during wet seasons and add moisture in the dry seasons. The optimum range for soil moisture is between 20 and 80%.

Oxygen: Any physical movement of the soil exposes contaminants to the air for volatilization and increases biodegradation. Working the soil in the treatment cell with a rototiller, disc, plow or windrow equipment will increase oxygen availability. The optimum oxygen range for bioactivity is 4 - 5%

pH: When soils are too acid or basic, nutrients become unavailable to the microorganisms because the nutrients bind to the soil particles or the nutrient form alters. Optimum pH is 7 and should be kept between 6 and 8.

Temperature: Biodegradation can occur between 20°F and 90°F. Activity is best at temperatures greater than 40°F and slows at the extreme ends of the range.

Responsible parties and contractors will need to evaluate treatment options and consider their costs and benefits. An advanced remediation system can be created by conducting pilot studies to determine the optimum site specific conditions for biodegradation. However, the cost of pilot studies, treatment and monitoring of several factors may be prohibitive. Recent studies and scientific research can be checked for current findings.

C. FIELD AND CONFIRMATORY SAMPLING

IDEM's two main concerns for land treatment are the following: that the contaminated soil is remediated and that the treatment location has not been contaminated by the treatment process.

1. Field sampling plans must include the following information:
 - a. schedule,
 - b. location,
 - c. procedures, and
 - d. equipment.

Field instruments can be used to determine initial contaminant levels and for quarterly report monitoring. Field instruments are not as accurate as lab analysis. However, field instruments do save time and money, while providing an estimate of the level of contamination. **Do not composite field samples.**

To compare monitoring results for the quarterly report, it is best to use the same type of instrument throughout the remediation process if possible. Always calibrate a field instrument before analyzing samples.

The number of field samples for monitoring purposes must be double the number required for final confirmatory sampling.

2. Lab sampling plans (necessary for confirmatory sampling) must include the following:
 - a. schedule,
 - b. location,
 - c. sampling procedures,
 - d. lab methods,
 - e. chain of Custody procedures, and
 - f. QA/QC procedures.

To confirm that the contaminated soil is remediated, soil samples must be collected and submitted to a lab for analysis. Use the methods and QA/QC procedures as outlined in the LUST SITE INVESTIGATION REPORT GUIDELINES (page 3-9). **Do not composite soil samples.** Sampling patterns must be designed to reduce bias and provide complete site coverage. Grid patterns are best suited for accomplishing these goals because sample locations are at constant distances apart. Actual sample locations need to be from the bottom third of the contaminated soil layer. Use the following table to determine the necessary number of samples required.

FIGURE V: FINAL LAND TREATMENT SOIL SAMPLING

CUBIC YARDS	TREATMENT CELL SAMPLES	UNDERLYING SAMPLES
0 - 10	1	1
11 - 100	2	1
101 - 500	3	1
501 - 1000	4	2
each additional 500	1	1

Once confirmatory sampling, at all sample points, indicates total petroleum hydrocarbon (TPH) levels have stabilized at less than the maximum soil contaminant level allowable, then the soils can be considered remediated, but must remain on-site.

To establish that the treatment cell location has not been contaminated by the remediation process, the soil underlying the barrier must be sampled and analyzed. As with the confirmatory samples, use the methods and QA/QC procedures outlined in the LUST SITE INVESTIGATION GUIDELINES (page 3-9).

D. PROGRESS REPORTING

Upon IDEM approval and implementation, progress reports and sampling results must be submitted. This must be reflected on a Corrective Action Progress Report Form for L.U.S.T Sites as found following page 3-18. At the end of the project, a final report must be filed to document that cleanup has been achieved. These reports must contain:

1. Brief narrative of the remediation process;
2. Data from the performance monitoring plan graphically displayed to show remediation effectiveness; and
3. Other documentation to support the conclusions.

ALL REPORTS MUST BE SIGNED BY AN EXPERIENCED ENVIRONMENTAL PROFESSIONAL (ENGINEER, GEOLOGIST, HYDROGEOLOGIST, C.H.M.M. , etc.)

Additional copies of the progress form are obtainable from IDEM at (317) 233-6418.

ADDENDUM TWO: OFF-SITE TREATMENT REQUEST

THE LEAKING UNDERGROUND STORAGE TANK PROGRAM HAS COMPILED THESE ADDITIONAL REQUIREMENTS TO BE USED IN CONJUNCTION WITH THE ON-SITE TREATMENT DOCUMENT.

The off-site treatment of contaminated soil will be allowed only when the owner of the LUST site is also the owner of the proposed treatment property. Conditions set forth in the land treatment guidelines document must be met before approval of the off-site treatment will be granted.

Before seeking approval for the off-site treatment of contaminated soils, the following information from both sites must be submitted.

A. Site Specific Information

1. LUST site information must include:
 - a. Owner/Operator Name
 - b. Facility name
 - c. Facility Address
 - d. Telephone number
 - e. LUST incident number
2. Off-Site information must include
 - a. Copy of deed or title
 - b. Legal description of property

B. Maps and Illustrations of the Off-Site property

1. Illustrated legends, compass directions at an appropriate scale;
2. A legible topographic base with ten foot intervals;
3. Location and depth of all private wells within a mile radius;
4. Surface water bodies within a mile radius;
5. Soil Conservation Service soil map and descriptions; and
6. Proximity to human health and environmentally sensitive areas (i.e. schools, woodlands, wetlands, etc.).

C. Transportation

The following guidelines must be met during the transportation of the material. In addition, IDEM requires that information concerning the logistics of the transportation also be included.

1. Load must be tarped to prevent rainwater infiltration, blowing of material, etc.
2. Hauler Information (Bill of Laden)
 - a. Name of company
 - b. Business address

- c. Telephone number
- d. Driver's name and Commercial Driver's License number
- 3. Amount of soil to be transported in tons or cubic yards
- 4. Initial TPH level
- 5. Date and time of transportation

Upon written receipt of an **off-site** treatment proposal, IDEM will respond in written format **within 14 days**. The IDEM letter will either approve or deny the request, or ask that additional information be submitted. Off-site contaminated soil transportation cannot begin prior to IDEM written approval. Please maintain a copy of the letter at both the LUST site and the treatment property. The land treatment process may begin immediately upon receipt of the approval letter.

If off-site soil treatment is requested during a UST closure over-excavation and land treatment corrective action plan proposal, then the UST Closure Report will not be considered as complete unless documentation as to the contaminated soil corrective action initiation, corrective action progress reporting and final corrective action status reports have been submitted.

The off-site treatment cells must be maintained until the soil contamination level is N.D. (Non-Detect). If, for any reason, treatment ceases or monitoring and reporting requirements are not met, the LUST section will have no alternative but to refer the site to IDEM'S Office of Solid and Hazardous Waste for enforcement action as illegally disposing of a special waste.

Please Note: The use of off-site property for land treatment of petroleum contaminated soils must not violate any local zoning laws or covenants nor may it be inconsistent with any third party agreements.

IDEM requests that the local fire and health departments of the off-site location be informed of the contaminated soil transportation and proposed land treatment.

VI. SELECTED REMEDIATION TECHNOLOGIES

A. SOIL

Various techniques can be applied to remediate petroleum contaminated soils. The ones listed below are the most common techniques. Since new alternative technologies will continue to be developed, this is a partial listing and is by no means complete. However, three basic soil remediation techniques can be identified. They are outlined below along with their advantages and disadvantages. These can be used separately or in combination to achieve effective remediation. **Remember: all applicable state and local permitting must be obtained before beginning any remediation process.**

1. Above ground (on-site)

These forms of soil remediation involve excavation of the contaminated soils for above ground on-site treatment. Care must be taken to limit all exposure to the contaminated soils during the initial excavation and remediation efforts.

a. land treatment

Land treatment involves spreading of the contaminated soils in a thin layer to enhance naturally occurring degradation processes (biodegradation and volatilization). The following three phases must be well documented: the treatment cell construction plans; the physical treatment procedures and a detailed sampling plan. Periodic applications of soil nutrients, water or increased oxygen exposure can aid in the remediation efforts. A detailed description of the procedures involving land treatment of contaminated soils can be found in the LAND TREATMENT GUIDELINES (petroleum contaminated soils) on page 3-23 of this guidance manual).

b. composting

Composting is the mixing of contaminated soil with organic matter to enhance the natural biodegradation. Like land treatment, it requires site control through the use of liners, berms, etc.. Its major advantage over treatment cell remediation is that it can be performed where space is limited. Major factors which need to be addressed are moisture control and pile aeration. These piles can be either static in nature with ventilation pipes placed throughout or they can be mechanically aerated through windrowing. These piles can be covered to help maintain moisture and aid in the collection of off-gases.

c. bioreactor

A bioreactor is where contaminated soils are excavated and mixed in a vat containing nutrients/solvent solution. The created slurry of soil and water mixture is then allowed to settle in large vats for dewatering. The collected liquid can then be either treated for reclamation or disposed of properly.

d. low temperature thermal desorption

Low temperature thermal desorption involves heating the contaminated soils in a closed chamber to temperatures that enhance contaminant volatilization. The off-gases pass through either an air emission control system or a vapor recovery system. These portable systems mount on semi-tractor beds and are generally more effective with gasoline contaminated soils as opposed to diesel or oil contaminated soils.

e. soil washing

Soil washing is a technique that removes the petroleum hydrocarbons from the on-site excavated soils by leaching the contaminants out into an aqueous phase. The contaminants can then be recovered. Water, with a detergent additive, is the most common liquid applied to the soils. The soil slurry can be dewatered by filtration, evaporation or sedimentation. The leachates are collected and treated by various techniques such as: distillation, evaporation, etc.. Preliminary laboratory and field pilot test studies need to be conducted to determine site effectiveness.

2. Below ground

Crucial to the success of any in-situ technique is proper soil characterization. The most common disadvantage in this form of remediation is poor performance of a selected technique because of improperly characterized soil conditions. This can lead to additional cost to correct the remediation technique utilized.

a. soil venting

Venting is any technique that removes hydrocarbon vapors from unsaturated soils. This process uses a system of vents with gravel packs or slotted well casings to move air and other gases through the soils. Passive systems are open to the atmosphere and do not require energy to activate. Active venting systems are preferred over passive systems. Wind driven turbines found atop well casings are considered passive vent systems. Active vent systems require the

use of either pressure pumps to force gas movement or vacuum pumps to collect the gases at various well points. Vapors are discharged into the atmosphere with the discharged contaminant levels determining whether treatment or recovery is necessary. Soil particle size, density and moisture are all limiting factors for this technique. Thus, proper soil analysis must be determined prior to the selection of this technology. Generally, soils with fine grains and limited pore space cannot effectively vent contaminants.

b. soil flushing

In situ flushing washes contaminants from soils through the use of a water/detergent mixture. The contaminant/water mixture is then collected by the use of recovery wells and treated above ground. Generally, effective cleaning of contaminants from the soil is difficult to control. Above-ground soil flushing techniques achieve better results through controlled soil/detergent mixing.

3. Above ground (off-site)

These processes involve the transportation of contaminated soil from the site to either a special waste landfill or to a permitted commercial treatment facility. Proper manifests for the transportation of the soil to any of these sites must be kept.

a. commercial treatment facilities

Commercial treatment facilities need modifications to their air permits before contaminated soil can be accepted and may need to be permitted by IDEM's Office of Solid and Hazardous Waste at (317) 232-3458.

(1) high temperature incinerators

Petroleum contaminated soils are added to the combustion chamber where the organic compounds are burned off. The vapors emanating from the chamber are directed to a series of air pollution control systems for treatment. All appropriate air emission regulations apply to the incinerator. Currently, few incinerators are allowed to accept petroleum contaminated soils. Proper permits must first be obtained. Please refer inquiries to IDEM's Office of Air Management at (317) 232-8427.

(2) asphalt/concrete plants

This technology is similar to the high temperature incineration process. Petroleum contaminated soils are introduced in small quantities to the burn chamber in the mix process of either asphalt or concrete products. Currently, few facilities are allowed to accept contaminated soils. Proper permits must first be obtained. Please refer inquires to IDEM's Office of Air Management at (317) 232-8427.

b. special waste landfill

This process involves the transportation of contaminated soils to a special waste landfill within Indiana. Proper documentation as to the quantity and origin of the soils must be kept and forwarded to IDEM. Soil testing is mandatory prior to landfill acceptance. Proper manifests for the transportation of the soils to the landfill must be kept. A listing of Indiana special waste landfills along with the appropriate waste disposal notifications are included in Appendix E of this manual.

B. GROUNDWATER

Several methods are available to remediate petroleum contaminated groundwater. A good understanding of site geology and hydrology must be known before cost effective remediation plans can be implemented. Air stripping, granular activate carbon adsorption and bioremediation are all viable treatment options. Generally, the most common techniques require some form of a "pump and treat" system together with either air stripping towers or with a carbon adsorption system. However, several other techniques such as air sparging can provide an option if site conditions are favorable. Air and water discharge permits must be applied for before initiation of remediation.

1. Below ground

In-situ treatment methods include: forced air introduction to the groundwater, bioremediation and aeration by hydrogen peroxide. The proper applications of these methods are dependent to site geology and hydrology. These techniques can be employed alone or together to provide cost effective remediation.

a. air sparging

Air sparging injects air under pressure below the groundwater table. Air bubbles form and migrate through the overlying soils. Contaminants are exposed to the introduced air and volatilize into a gaseous phase which then

can be collected. The combination of air sparging and soil vapor extraction technologies greatly decreases the required remediation time.

2. Above ground (on-site)
 - a. pump and treat
 - (1) pump and treat systems extract groundwater along with contaminants to various above ground treatment systems. Air stripping involves mixing the contaminated groundwater with oxygen to promote the diffusion of the volatile organic vapors. Then the treated groundwater can be either properly reinjected back into the site subsurface, discharged into a waterway (**NPDES permit required**) or through a local sanitary sewer (**prior WWTP permission required**). The carbon canisters need to be replaced and cleaned regularly and properly disposed.
 - (2) activated carbon canisters may be used with air strippers or alone to filter out dissolved petroleum hydrocarbon contaminants

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